Superfluid Phases in ^{3}He

Nobel Prize 1996

What is it?!

Helium-3 (two protons and one neutron) was discovered to have superfluid properties when subjected to temperatures near absolute zero Kelvin.

That's Cool... Who Discovered It?

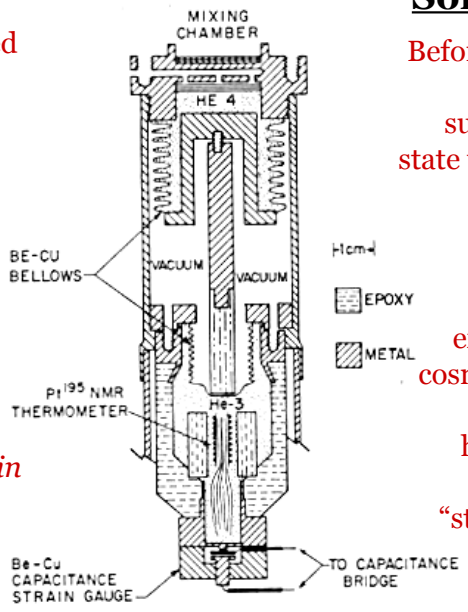
Discovery made by David M. Lee and Robert C. Richardson of Cornell University, and Douglas D. Osheroff of Stanford University.

Wait, what's a superfluid?

Superfluidity is "*a state of matter in which matter behaves like a fluid with zero viscosity; where it appears to exhibit the ability to self-propel and travel in a way that defies the forces of gravity and surface tension*".[1]

... In English?

When brought near absolute zero Kelvin, the liquid is able to flow through any obstacles and through pores while subject to its own inertia as a fluid.



Some Background On the Experiment

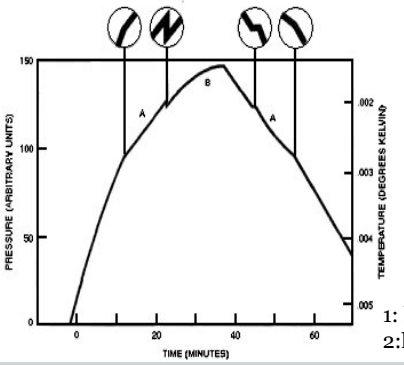
Before the experiment was conducted, heavy amounts of theory surrounded the idea of Helium-3 having a superfluid phase. Though proposed by many, the true state was not observed until 1972, when Lee, Richardson, and Osheroff performed this experiment.

What are some applications?

Superfluid Helium-3 has been used to bring experimental evidence to the theory of cosmic strings; cosmic strings are thought to have been important in the early formation of galaxies. Essentially, by rapidly heating the superfluid Helium-3 by neutrino-induced nuclear reactions, scientists were able to create "structures" that may be shown to have a connection to cosmic strings.[2]

The Experiment!

As per the graph to the right, liquid ^{3}He was put under extreme external pressure for around 40 minutes, where it was then allowed to be decompressed. The extreme external pressure cooled the liquid ^{3}He to around nearly 2 thousandths of a degree above absolute zero Kelvin. At this temperature, the properties of the liquid Helium changed, which was observed through the slope of the curve.



Further Experimentation

To verify that the supercooled Helium-3 in the experiment was infact in a superfluid state, researchers observed the damping of a spring inside the fluid. As the liquid helium changed phases, the spring was no longer acted upon by friction, allowing the damping force to essentially drop to zero.

1: http://en.wikipedia.org/wiki/Superfluidity
2:http://www.nobelprize.org/nobel_prizes/physics/laureates/1996/press.html